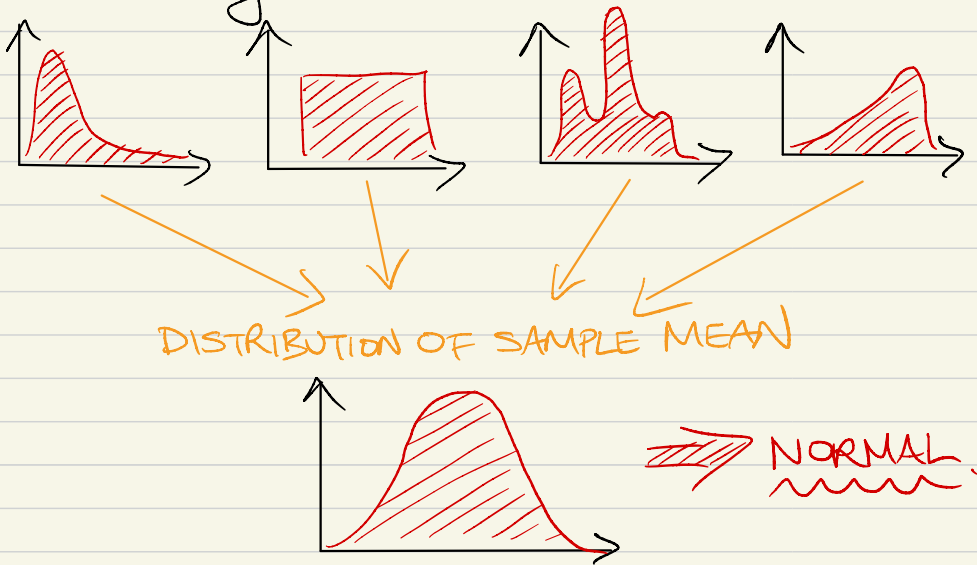


Lecture 4

01/27/22

• Central Limit Theorem

- Pick N random numbers from any $h(x)$ [tails must fall off faster than $1/x^2$].
- Mean of those N samples will converge to a Gaussian as $N \rightarrow \infty$.



Amazing! Underlies the reason why repeat observations improve measurements as $1/\sqrt{N}$.

- Multivariate pdfs

- Characterizing pdfs in more than one dimension or parameter.

- Multivariate Gaussians

$$p(x|\mu, \sigma) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{1}{2}\frac{(x-\mu)^2}{\sigma^2}}$$



$$p(\vec{x}|\vec{\mu}, C) = \frac{1}{\sqrt{\det(2\pi C)}} e^{-\frac{1}{2}(\vec{x}-\vec{\mu})^T C^{-1}(\vec{x}-\vec{\mu})}$$

$$C = \begin{pmatrix} \sigma_1^2 & 0 & 0 \\ 0 & \sigma_2^2 & 0 \\ 0 & 0 & \sigma_3^2 \dots \end{pmatrix}$$

- Correlation coefficients

- Parametric \Rightarrow Pearson's ... $r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}}$

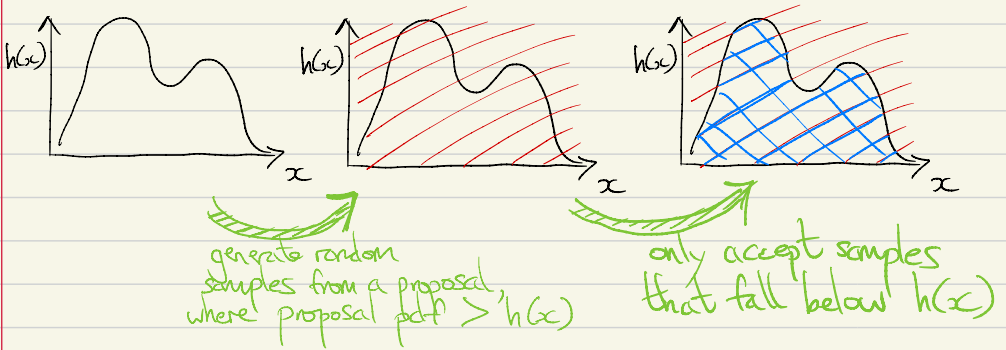
SUSCEPTIBLE TO OUTLIERS

- Non-parametric \Rightarrow SPEARMAN'S ... as Pearson's but with sample **ranks**

\Rightarrow KENDALL'S ... compares the # samples with same + different **sign**

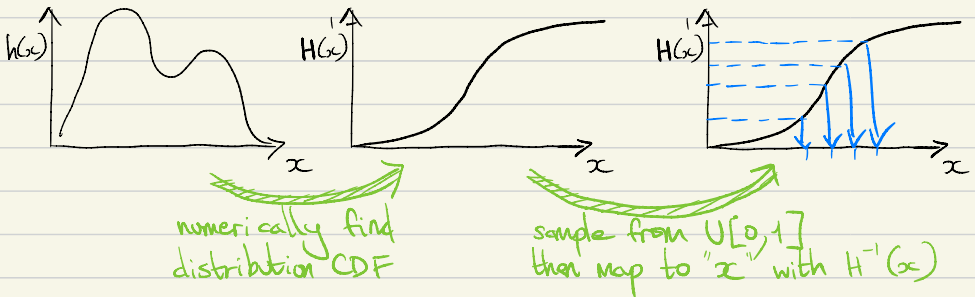
- Sampling from arbitrary distributions

- ① Rejection sampling



➡ what if we didn't have to waste samples?

- ② Inverse transform sampling



➡ easy, no waste!

↳ only really works in 1D though...